EXHIBIT 1

UNITED STATES DISTRICT COURT

SOUTHERN DISTRICT OF NEW YORK

In Re: Methyl Tertiary Butyl Ether ("MtBE") Products Liability Litigation	MDL No. 1358 Master File C.A. No. 1:00-1898 (SAS)

This document relates to the following cases:

City of New York v. Amerada Hess Corp., et al.

04 Civ. 3417

EXPERT REPORT OF

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MTBE Expert Report

February 2009

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- Biologically Active GAC
- Resins

The updated literature review revealed little new published information for all five of the technologies since the March 2007 evaluation. A summary of the recent findings is presented below:

- It was determined that both biologically active GAC and resins are still in the development phase. Therefore, biologically active GAC and resins require further research before they should be considered for MTBE removal at potable water installations, including NYCDEP's groundwater wells (Raynal, 2008; Waul, 2008; Ji, 2009; Lu, 2008; AWWARF, 2007).
- Advanced oxidation processes also remain very young technologies. From the new literature review, it was evident that the success of this technology is highly dependent on testing parameters such as: influent MTBE concentration, pH, temperature, contact time, AOP technology type and dose. In some instances, AOPs were determined to be unsuccessful technologies for the treatment of MTBE from potable waters with removals reported at less than 50%, while at other operating parameters, more than 99% reduction was achieved (Acero, 2001; Chang, 2000; Hu, 2008, Keller, 1998; Li, 2008; Sutherland, 2004). However, more remains to be learned about this technology, especially with respect to potential by-product formation, sizing, optimal placement in the treatment train, and peroxide dose. Thus, AOP is not considered to be a feasible VOC removal technology for Station 6 or the Individual Wells.
- As determined in 2004 and 2007, the current evaluation concluded that air stripping (with vapor-phase GAC) and GAC remain the most viable processes for the removal of MTBE at potable water facilities, including Station 6. Air stripping (with vapor-phase GAC) and GAC are both mature technologies with a number of full-scale drinking water applications making them applicable for implementation at NYCDEP's Station 6 Demonstration plant or the Individual Wells (Malcolm Pirnie, 2007c).

Additional background on MTBE treatment technologies can be found in the *Technical Memorandum, Evaluation of Options for Removal of Volatile Organics*, July 2004 (Malcolm Pirnie, 2004a) and the *MTBE Technology Update Memorandum*, March 29, 2007 (Malcolm Pirnie, 2007c).

9.3.2. Challenges Associated with MTBE Removal

Although air stripping installations have shown to be successful for the removal of MTBE from water when the concentrations are less than 1000 µg/L, the air handling requirements are often significant (as compared to removal of other volatile organic compounds) resulting in increased space requirements, operational complexity, and capital costs (Dyksen, 1999; McKinnon, 1984; NWRI, 2000). MTBE has a relatively low Henry's Law constant (K_H) that ranges from 0.018 at 20°C to 0.123 at 25°C (NWRI, 2000; Keller, 1998), which is indicative of MTBE's properties that once it is dissolved in

water, it is difficult to volatilize back into the gaseous phase. Therefore, air stripping requires a larger air-to-water ratio (often greater than 100:1) for MTBE applications in comparison to other VOCs, such as tetrachloroethylene (PCE), which typically only requires an air-to-water ratio of 40:1 in packed bed applications (Ramakrishnan, 2004).

MTBE removal via GAC is influenced by the competition for adsorption sites from other organic compounds including volatile organic compounds and natural organic matter (NWRI, 2001). For example, PCE has a higher adsorbability as compared to MTBE suggesting that if both PCE and MTBE are present, PCE will adsorb to the carbon before MTBE, resulting in fewer adsorption sites available for MTBE removal (ETDOT, 2001). MTBE requires longer contact times for GAC (as compared to other organic compounds) to contain the mass transfer zone within the adsorber, resulting in increased space requirements and capital costs (Sutherland, 2004). In addition, once the carbon becomes saturated with MTBE, it can no longer remove MTBE from the water and therefore the carbon must be replaced. Even at low influent concentrations, MTBE breakthrough can occur rapidly, resulting in a high carbon change-out frequency and increased operational costs (NWRI, 2001).

In addition to the challenges highlighted above, the following considerations also impact the treatment of MTBE:

- Concentration of MTBE in the raw water supply
- Duration that the MTBE will impact the water supply
- Presence of other VOCs, such as PCE, in the water supply
- Presence of MTBE degradation products, such as tertiary butyl alcohol (TBA), in the water supply

These challenges are addressed in the discussions below specific to Station 6 and the Individual Wells.

9.3.3. Station 6 Process Design Basis

This section describes the design basis for providing MTBE treatment at the Station 6 Demonstration Plant. Design criteria for the following are discussed:

- Design flow rates
- Raw water design criteria
- Finished water design criteria

9.3.3.1. Design flow rates

The maximum, average and minimum raw water flows that could enter the treatment plant were established previously by Malcolm Pirnie and are discussed in the *Technical Memorandum, Evaluation of Options for Removal of Volatile Organics*, July 2004

Table 9-3.
Air Stripping Design Criteria

Criteria	Alternative 1A		Alternative 1B	
Flow Rate (mgd)	7.5	10	7.5	10
Maximum MTBE Concentration (µg/L)	95	70	95	70
No. of Air Strippers in Use	3	3	4	4
Total No. of Air Strippers	4	4	5	5
Type of Operation	Parallel	Parallel	Parallel	Parallel
Maximum Flow Rate Per Tower (mgd)	2.5	3.3	1.9	2.5
Tower Diameter (ft)	12	12	12	12
Packing Depth (ft)	36	36	36	36
Packing Material	Tripacks No. 2	Tripacks No. 2	Tripacks No. 2	Tripacks No. 2
Tower Material	316L Stainless Steel	316L Stainless Steel	316L Stainless Steel	316L Stainless Steel
K_{La} Safety Factor	0.6	0.6	0.6	0.6
Henry's Constant for MTBE (dimensionless)	0.0397	0.0397	0.0397	0.0397
Maximum Blower Capacity (acfm)	30,200	34,100	38,300	46,500
Maximum A:W Ratio	130	110	220	200
Liquid Loading Rate (gpm/ft^2)	15	20	12	15
MTBE Finished Concentration (µg/L)	<3.0	<3.0	<1.0	<1.0
Minimum MTBE Removal Efficiency (%)	96.8	95.7	98.9	98.6

Off-gas Treatment

Vapor-phase GAC would provide the treatment of off-gas prior to discharge to the atmosphere. Vapor-phase GAC adsorption is similar to liquid phase adsorption (Malcolm Pirnie, 2004a; Malcolm Pirnie, 2007e). The VOC affected air from the stripping process must be captured and treated in order to comply with NYSDEC Air Guide-1 Annual Guideline Concentrations (AGC) and Short-term Guideline Concentrations (SGC). Additionally, the off-gas treatment system must meet any requirements set forth in all air permits established by NYCDEP (Malcolm Pirnie, 2004b). The permitting process and requirements would need to be further evaluated during the conceptual and final design phases. As discussed above, NYSDEC may require additional project components that could increase capital costs (e.g., second phase of treatment prior to discharge). Refer to the *Station 6 Demonstration Plant Conceptual Design Report* for additional discussion on permitting (Malcolm Pirnie, 2004b).

The process air system would be comprised of air intakes and filters, intake silencers, fans, discharge silencers, air stripping towers, heat recovery units, heaters, and vapor-phase GAC units. Refer to the *VOC Removal Alternatives Analysis Technical*